Supplementary Information

**Ultrathin nanoporous metallic films and their integration in sensors**

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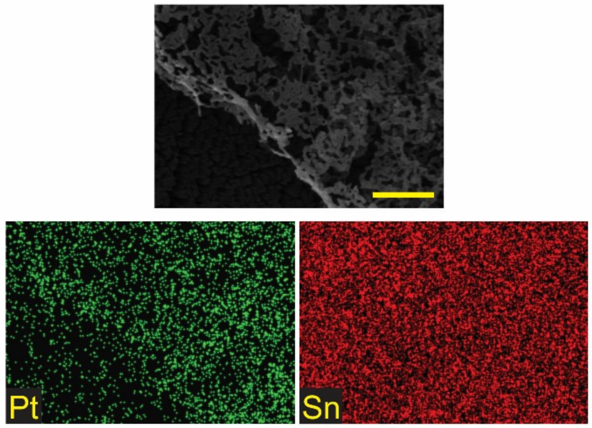
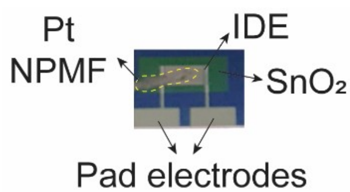
**Supplementary Table 1**. Various NPMFs fabrication conditions

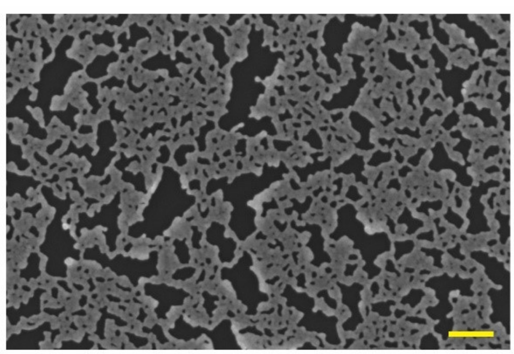
| **Metal/Metal alloy** | **PMMA (wt.%)** | **Plasma condition (power/ambient/time)** |
|---|---|---|
| Au | 1.5 | 200W/air/5min |
| Au | 5 | 200W/air/5min |
| Pt | 5 | 350W/W10 (Ar 90 %, $H_2$ 10 %)/15min |
| Mg | 1.5 | 150W/W10 (Ar 90 %, $H_2$ 10 %)/15min |
| Al | 2.5 | 300W/W10 (Ar 90 %, $H_2$ 10 %)/10min |
| NiFe | 5 | 300W/W10 (Ar 90 %, $H_2$ 10 %)/15min |
| AuAg | 5 | 200W/Ar/10min |
| AuPt | 5 | 200W/air/10min |
| PtPd | 5 | 300W/W10 (Ar 90 %, $H_2$ 10 %)/15min |



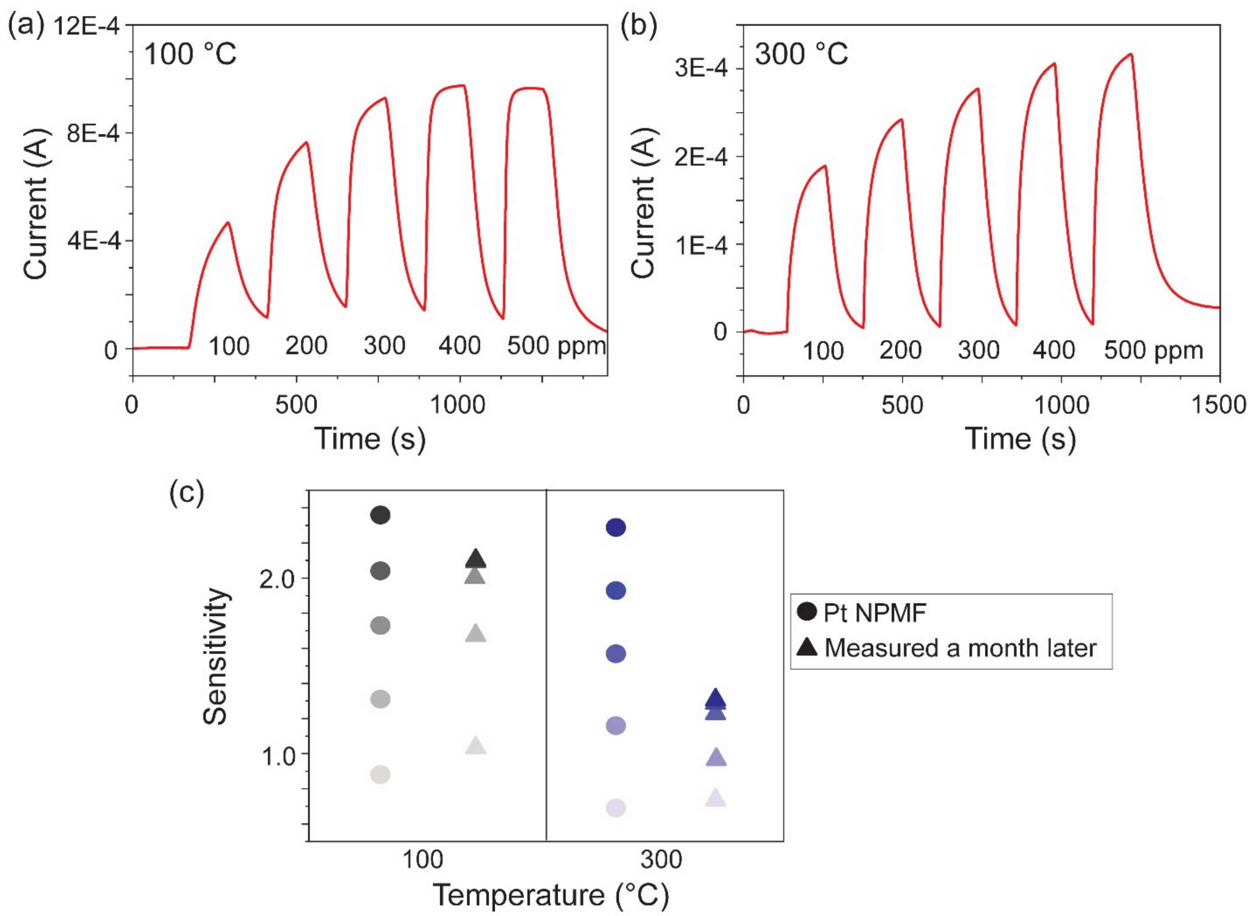

**Supplementary Figure 1.** SEM-EDX mapping of Pt NPMF coated $SnO_2$ nanostructures. The focus is placed on regions where the $SnO_2$ nanostructures are exposed. $SnO_2$ is uniformly deposited on IDE. The Pt NPMF exhibits a uniform coverage across the SnO2 layer, which demonstrates the effective transfer.



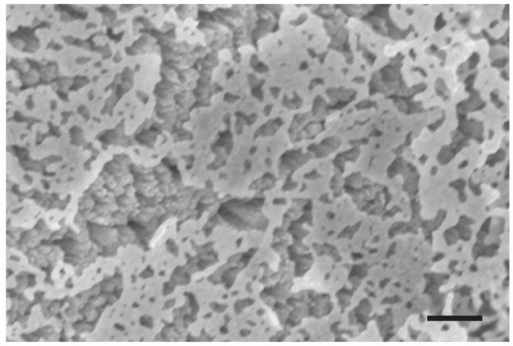

**Supplementary Figure 2.** Optical image of the sensor device. $SnO_2$ nanostructures are grown on the IDE, and Pt NPMF was transferred onto the active region as shown with the yellow dashed line.



**Supplementary Figure 3.** SEM images of Pt NPMF after annealing at 500 ˚C for 2 hours in air. There is no significant morphological change. Scale bar: 200 nm.




**Supplementary Figure 4.** Concentration-dependent $H_2$ sensing measurement results with the Pt NPMF transferred onto the sensor, measured a month after fabrication and using the same device, at a voltage of 0.1 V. Sensor operating temperatures are, respectively, (a) 100 ˚C and (b) 300 ˚C. $H_2$ at a concentration of 100, 200, 300, 400, and 500 ppm were exposed consecutively. $H_2$ exposure and dry air purging were repeated for 2 minutes each. Baseline of the current was subtracted from the original data to visualize the difference in current during $H_2$ exposure. (c) Sensitivity comparison. The observed saturation of sensitivity values at high concentrations are attributed to the storage of the sensor device in a humid air environment for a month, which may have led to the degradation of the $SnO_2$ nanostructures.



**Supplementary Figure 5.** SEM image of Pt NPMF on $SnO_2$ nanostructures after repeated gas sensing measurements and storage in humid air for a month. Scale bar: 200 nm.

**Supplementary Table 2**. Comparison of various techniques to fabricate NPMFs.

| Method Name | Materials | Sacrificial metals | Ultrathin | Transfer | Purity | Ref |
|---|---|---|---|---|---|---|
| Dry synthesis | Au, Pt, Mg, Al, metal alloys, etc. | X | 2D-like | O | Ultrapure | This work |
| Dealloying | Au, Pt, Pd, Cu, Ag, etc. | O | Bulky | X | Second metal remained | [1] |
| Vapor dealloying | AuCu | O | 2D-like | O | Second metal remained | [2] |
| Gelation | Au | X | 2D-like | O | - | [3] |
| Electrochemical | Cu | O | Bulky | X | Second metal remained | [4] |
| AAO-assisted | Pt | X | Bulky | X | - | [5] |
| Self-assembly | Au | X | 2D-like | O | - | [6] |

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